Project No. RP-1

COMPREHENSIVE RESEARCH ON RICE
ANNUAL REPORT

January 1, 1983 - December 31, 1983

PROJECT TITLE: Weed Control in Rice and Improvement of Agronomic Practices for Rice Production

PROJECT CO-LEADERS AND PRINCIPAL UC INVESTIGATORS:

Co-leaders: D. E. Bayer, J. E. Hill and D. E. Seaman

Investigators: Farm Advisors - S. C. Scardaci, J. F. Williams and C. M. Wick; Research Assistants - M. LeStrange, D. Kovach and B. McKlosky; Post Graduate Research Assistant, J. Wrysinski; Staff Research Associates - B. Brandon and E. Roncoroni; Field Assistants - T. Woolsey and P. Toor.

LEVEL OF 1982 FUNDING: $73,605 (Bayer - $26,700; Hill - $16,905; Seaman - $30,000)

OBJECTIVES AND EXPERIMENTS CONDUCTED BY LOCATION TO ACCOMPLISH OBJECTIVES:

I. To develop new chemical methods of weed control in rice and to improve the efficacy and safety of herbicides now in use.

   A. To evaluate new herbicides for potential use in rice.

   B. To develop procedures for the use of promising experimental herbicides and to improve use of commercially available herbicides.

   C. To evaluate herbicides and develop application methods for control of weeds on rice field levees.

II. To develop integrated rice management systems.

   A. To evaluate the influence of rice plant height on competition on rice growth and development and to document the benefits of various weed control methods.

   B. To evaluate fertilizer management methods to minimize weed problems in rice.

   C. To assess the influence of water management on the growth and competition of rice field weeds.

D. To continue cooperative studies of varietal herbicide tolerance with rice breeders to insure that rice herbicides will not injure present and future California rice varieties.

III. To investigate the biology of rice weeds and their ecological relationships with rice in the field.

A. Continue studies of the influence of environmental factors on the germination and growth of smallflower umbrellaplant.

B. Further studies of the relative competitiveness of early and late watergrasses with water-seeded rice, of the causes of their changes in predominance in rice fields, and of some new methods for limiting their distribution and reducing the severity of their infestations.

C. New studies of the growth and spread of the perennial weeds Gregg's arrowhead, roughseed bulrush, river bulrush, and common waterplantain in response to cultural practices (e.g. fall vs spring plowing) and chemical control methods.

SUMMARY OF 1983 RESEARCH (MAJOR ACCOMPLISHMENTS) BY OBJECTIVE:

Objective I

Several experimental herbicides were evaluated at the Rice Experiment Station, Biggs, and at the Rice Research Facility, Davis. Studies were also conducted at these two locations and at the Demeter Corporation, Sacramento County, to improve the efficacy of existing herbicides by (1) altering timing, (2) combining herbicides, (3) the addition of adjuvants and (4) changes in formulation.

A. Herbicide Evaluation.

Fifteen experimental herbicides were evaluated at the Rice Research Facility, UC Davis, and/or at the Rice Experiment Station, Biggs. Two of the 15 herbicides were reevaluated from the 1982 screening trials (Tables 1-4). A growth regulator from Mobay Corporation was tested at Biggs to determine its effect on rice yields.

1. Hoe-33171 (American Hoechst Corporation) was evaluated for post-emergence control of barnyardgrass at Biggs and UC Davis. Applications were made from early (1-2 leaf) to late growth stages of barnyardgrass. For the early applications at UC Davis the flood water was removed before treatment to expose as much foliage as possible. At Biggs the flood water was maintained at 3-4 inches during all herbicide applications.

At UC Davis the 0.3 and 0.15 lb ai/A rates at the earliest application controlled barnyardgrass 100% and 80%, respectively, but caused severe stunting of the rice and reduced rice yield. The 0.075 lb ai/A rate caused less stunting but only gave 50% barnyardgrass control. At the 5-inch barnyardgrass growth stage the 0.31 lb ai/A rate gave 100% control and the 0.15 lb ai/A gave 70%. The 0.075 lb ai/A stunted the barnyardgrass plants temporarily. Treatments at the 5-inch stage caused less visual rice injury, however, stunting was visible at the higher rates. At the first two applications the yield was higher than the untreated plots but only 50% or less of the thiobencarb 4 lb ai/A standard treatment applied at the 2-leaf growth stage of the rice. Lower yields when compared to thiobencarb may have been due to early control of broadleaf weeds such as smallflower umbrellaplant by thiobencarb. When Hoe-33171 was applied at the 9-inch growth stage of the barnyardgrass at UC Davis, the 0.3 lb ai/A gave 75% control, 0.15 lb ai/A gave 50% control, and 0.075 lb ai/A gave less than 50% control. Some reduction of rice plant height was observed with the late applications and rice yield was 60% below that of the standard thiobencarb treatment (Table 1).

At Biggs the early applications applied without lowering the flood water resulted in little or no barnyardgrass control or rice injury. The midtillering treatment (0.4 lb ai/A) controlled 90% of the early barnyardgrass and 80% of the late barnyardgrass. This treatment decreased the rice height by 12% but gave 36% yield increase over the untreated plots and a slight 4% increase over the standard molinate 3 lb ai/A preplant incorporated treatment (Table 2).

Later treatments of Hoe-33171 with and without the addition of a surfactant were made at Biggs when the rice was tillering (10 inches tall) and again during elongation (15 inches tall). There was an increase in rice leaf burn with the addition of the surfactant over Hoe-33171 alone but no increase in barnyardgrass control. Plant height and rice yield were affected minimally (Table 3). Hoe-33171 did not control smallflower umbrellaplant or roughseed bulrush in tests at UC Davis or Biggs. The combination of Hoe-33171 at 0.15 lb ai/A and bentazon at 1.0 lb ai/A with 1% v/v oil concentrate gave season-long control of barnyardgrass (70%) and 70% control of roughseed bulrush and smallflower umbrellaplant (Table 1). Sedges that germinated after treatment were not controlled.

2. <u>SC-2957</u> (Stauffer Chemical) applied preflood surface and at the 2-leaf growth stage of the rice did not injure the rice or control barnyardgrass, broadleaf weeds, smallflowered umbrellaplant or roughseeded bulrush at UC Davis (Table 4).

3. <u>SC-0254</u> (Stauffer Chemical) showed severe rice phytotoxicity when applied preflood at Biggs. Formulation problems with this compound prevented granules from settling through the water for the postflood treatments (Table 4).

4. <u>Molinate + 33865</u> Safener (Stauffer Chemical) showed no benefit in preventing rice stand reduction from high rates of molinate at Biggs. Applied preflood incorporated at UC Davis, the 3.0 lb ai/A molinate plus the 33865 safener did increase season-long barnyardgrass control (70%) over molinate alone preflood incorporated (33%) (Table 4).

5. <u>FMC-72980</u> (FMC Corporation) applied preflood surface at UC Davis at rates of 0.5, 1.0, and 2.0 lb ai/A reduced the barnyardgrass population but caused a severe rice stand reduction especially at the higher rates. Treatments made at the 2 1/2-leaf and 5-leaf growth stages of the rice did not cause rice injury or stand reduction but provided little or no weed

control (Table 4).

6. BASF-51405H and BASF-51602H (BASF Wyandotte Corporation) were unsuccessful at Biggs in controlling roughseed bulrush, spikerush, smallflower umbrellaplant, or barnyardgrass.

7. RH-0265 (Rohm and Haas) applied at Biggs reduced rice stand and exhibited no successful control of roughseed bulrush, waterhyssop or barnyardrass.

8. RH-1903 (Rohm and Haas) was evaluated for the second year at Biggs. Although there was no phytotoxicity to the rice 8 lb ai/A were required to increase barnyardgrass control over the preflood molinate treatment. Broadleaf weeds or sedges were not controlled.

9. Zoecon Experimental Herbicides. Five new compounds from Zoecon were applied preflood and at the 2-leaf growth stage of rice at Biggs and UC Davis in preliminary ring tests. One experimental herbicide showed promise at Biggs for the control of roughseed bulrush and barnyardgrass without excessive injury to the rice. At UC Davis the same five compounds showed less promise for the control of the weeds when compared to the standard molinate and thiobencarb treatments.

10. DPX-5384 (DuPont). In the third year of field testing at Biggs, DPX-5384 was evaluated at six rates and three times of application. Early barnyardgrass ratings made 46 days after the final treatment (4-leaf growth stage of rice) showed lower barnyardgrass levels at the higher chemical rates than the standard thiobencarb treatment. There were no apparent phytotoxic affects on the rice except from the highest rate made preflood surface (Table 4).

DPX-5384 applied at Davis, at the 1 1/2 and 4- to 5-leaf growth stage of the rice, at 30, 40, 60 and 80 g/A gave less than 50% barnyardgrass control at the highest rate (200 g/A). DPX-5384 gave little or no control of the broadleaf weeds or sedges. Molinate at 5 lb ai/A and thiobencarb at 4 lb ai/A applied at the 2-leaf growth stage of the rice each gave 90% barnyardgrass control (Table 4).

11. RSW-0411 (Mobay Corporation), a growth regulator, was tested at Biggs on short and tall stature rice to determine its effect on agronomic characters and yield. These results are not analyzed at the time of this reporting.

B. Improved Procedures for Herbicide Use.

MCPA-Basagran Combinations. Applications of MCPA were made to rice 25, 35, 45, and 55 days after seeding. The stages of rice growth were well rooted and beginning to tiller, tillering vigorously, tillers fully developed, and at elongation. A second or split application was made using either bentazon or MCPA following the original application of MCPA by 10, 20, 30, or 40 days. The flood water was lowered to expose the weed foliage and returned 24 hours following application of the herbicide.

The early application of MCPA did an excellent job of controlling the young seedlings that had fully emerged but those plants that emerged after the herbicide application were not controlled. Thus the overall weed control for the 25 days after seeding treatment was poorer than the treatments made 35 days after seeding. Early applications of MCPA provided better weed control and had less effect on rice yields than did applications made 45 or 55 days after seeding (Table 5).

Split applications in which bentazon followed MCPA controlled only those weeds that germinated after the MCPA application. Plants not killed by the MCPA application had started to tiller and flower and were too well established to be controlled by the bentazon. Although leaf burn was apparent these planta continued to grow and compete with the rice.

Bentazon was applied to rice 25 and 35 days after seeding. The stages of rice growth were (1) well rooted and beginning to tiller and (2) tillering vigorously. A second or split application of MCPA followed the original application of bentazon by 10, 20, 30, or 40 days. The flood water was lowered to expose the weed foliage and returned 24 hours following the application of the herbicide. No application of bentazon controlled all the weeds especially the sedges. Best control was obtained when bentazon was applied to young weeds that had not tillered or started to flower (Table 6).

In split applications where MCPA followed bentazon best weed control was obtained when MCPA was applied before those plants that escaped the initial bentazon treatment had flowered. Rice responded the same to split application involving MCPA as to single applications of MCPA, therefore, the earlier the MCPA was applied in the second application the less the effect was on rice yield.

Thiobencarb (Bolero) Timing Experiment. Thiobencarb was applied at 0, 4, 6 and 8 lb/A at four different times: to the soil surface and incorporated; to the soil surface and unincorporated; postflood-preseed; to the 1-leaf stage of the rice; and to the 2-leaf stage of the rice.

All treatments of thiobencarb applied before the 2-leaf growth stage of the rice caused a reduction in the stand of rice. The postflood-preseed treatment and the 1-leaf growth stage reduced the rice stand to 5 plants per square foot and 6 plants per square foot, respectively. Barnyardgrass and sprangletop were completely controlled by all treatments of thiobencarb. Control of smallflower umbrellaplant and red stem was only 50 to 60% in this study (Table 7).

The yield of rice was reduced at both the postflood-preseed and the 1-leaf growth stage of the rice which corresponded to the treatments causing the greatest injury to the rice.

Bolero (Thiobencarb) and Ordram (Molinate) Combinations. Combinations of molinate with thiobencarb as a second or split application were evaluated for safety to the rice and to improve weed control. When molinate was applied first, it was applied either preplant incorporated or at the 1-leaf growth stage and thiobencarb followed when the barnyardgrass was in the 2-leaf stage. When thiobencarb was applied first, the rice was in the

2-leaf stage and molinate followed when the barnyardgrass was approximately 4 to 5 inches tall.

All treatments that included thiobencarb provided better sprangletop, smallflower umbrellaplant and red stem control than molinate alone. No herbicide treatment or combination of herbicide treatments expressed injury to the rice (Table 8).

Herbicide Coverage/Weed Control Trial (Colusa County). A trial was established to test herbicide coverage under grower field conditions using a fixed-wing aircraft to apply bentazon with three different volumes of water (7.5, 10 and 20 gallons). The spray coverage and pattern of the different treatments were recorded using four water sensitive cards per plot placed on small portable platforms. Weed population data was collected before and two weeks after the application. Weed control ratings were also made two weeks after the application.

Results show that bentazon applied at 20 gallons per acre gave distinctly better coverage than at 10 or 7.5 gallons per acre as recorded on water sensitive cards. These cards are being analyzed for percent area covered by spray droplets. Of the two main weeds in the field (ducksalad and waterhyssop), weed control was best when the herbicide was applied with 10 or 20 gallons of water. Though not significantly different, control of these weeds was lower at 7.5 gallons of water than at 10 or 20 gallons.

C. Levee Weed Control

No experiments were conducted on levee weed control in 1983. Experiments will be conducted in 1984.

Objective II

The integration of cultural and chemical methods is essential to successful rice weed control. No herbicide currently available is capable of controlling weeds in the absence of vigorous rice stands, appropriate water management and other cultural aids. Studies were conducted at the Rice Experiment Station, Biggs, and at the Demeter Corporation, Sacramento County, to fine-tune herbicide use in conjunction with cultural practices.

A. Weed Competiton

Studies on barnyardgrass competition and on the rice yield enhancer R-33865 proposed for the Rice Experiment Station by Dr. Don Seaman were deleted from the 1983 program. Field studies on the competition of barnyardgrass to tall and short-stature rice were conducted in the 1981 and 1982 seasons. This work established data for the cost and benefit of barnyardgrass competition in support of herbicide registration and has been summarized in previous reports to the Board. Additional research is currently in progress on the biology of barnyardgrass biotypes and is summarized in a later section of this report.

B. Fertilizer Management and Weed Control

The effect of the herbicides MCPA and bentazon were studied at the Rice Experiment Station and in Sacramento County. In previous studies, MCPA applications have been followed by an initial depression of leaf tissue nitrogen, then a recovery, relative to untreated and bentazon-treated plants. The 1983 studies looked more closely at the dynamics of this depression and at yield as they relate to applied nitrogen level and to topdressing of nitrogen at 30 lbs N/acre at the time of herbicide application. Bentazon and MCPA were applied at 1 lb ai/acre. The results of the leaf tissue analysis for the 1983 experiment are not yet available. Pending their analysis, it appears necessary to look more closely at various nitrogen management practices and/or fertilizer sources in conjunction with the full range of MCPA application timings which growers use in hopes of answering questions regarding (1) nitrogen management, especially timing of nitrogen application for growers using this material, (2) effect of those two factors on rice plant growth and development, and (3) relationships of these two factors with weed and disease control.

C. Water Management Study

An expanded version of the 1982 study in Sacramento County was established, with the six water management treatments replicated twice, for a total of 12 basins. Replicated herbicide treatments were made within each basin, comparing materials, timing and rates. Extensive rat damage and very late planting prevented meaningful harvest of this trial. The only usable data from the experiments are weed and rice stand counts and weed control ratings. This data is currently being analyzed.

D. Rice Tolerance of Herbicides

Hoe-33171 was applied to five varieties of rice and to barnyardgrass in the greenhouse at UC Davis. The rice varieties (M-9, S-201, M-201, L-201 and Cal Pearl) were selected to cover the range of grain and germplasm types grown in California. The rice and barnyardgrass were planted into 4-inch pots and thinned to 4 plants per pot. Hoe-33171 was applied at 0.30, 0.15, and 0.075 lb ai/A to the rice when the rice plants reached the 3- to 4-leaf stage of growth. Plants were returned to the greenhouse for two weeks before they were measured and harvested for plant weight. Generally at this time the barnyardgrass plants had died and new growth was showing on the treated rice plants. The 0.075 lb ai/A rate showed little or no height reduction whereas all other rates produced some reduction in height. Whether or not the lower rates will provide enough weed control in the field needs further study.

Objective III

Laboratory and greenhouse studies were conducted at UCD on the light and germination requirements of smallflower umbrellaplant. Germination studies were also initiated on barnyardgrass to determine differences, if any, between the two major biotypes. This research will provide basic information to build on weed control strategies in the field.

A. Biology of Smallflower Umbrellaplant.

Smallflower umbrellaplant was shown to have a light requirement for germination. Smallflower umbrellaplant seeds were germinated on a temperature gradient bar both in the light and in the dark. When the seeds were germinated in the light, the growth pattern described in the 1982 annual report was obtained (limited germination began at 60°F and increased to 80% at 70°F and finally 100% at 85°F). When an exact study was conducted in the dark no germination occurred at any of the temperatures (50°F - 85°F). Subsequent studies have shown that the light requirement is not sensitive to temperature and can be satisfied with red light.

B. Biology of Barnyardgrass

Germination tests of seed of both early and late barnyardgrass were conducted on a temperature gradient bar. Germination occurred over a wide temperature range from 13°C (56°F) to 30°C (86°F). Early barnyardgrass germinated quicker at a given temperature than did the late barnyardgrass. This was particularly true at the cooler temperatures. At 13°C early barnyardgrass had achieved 60% germination by 9 days after planting while it took 12 days for the late barnyardgrass to reach an equivalent percent germination. After 2 weeks 70 to 80% of the barnyardgrass seed had germinated. When compared to rice (M-9) only 14% had germinated at this temperature and even at 16°C only a little over 50% had germinated by the end of 2 weeks (Table 10).

C. Perennial Weed Biology

PUBLICATIONS OR REPORTS:

Bayer, D. E., J. E. Hill, and D. E. Seaman. 1982. Weed Control in Rice and Improvement of Agronomic Practices for Rice Production. Annual Report, Comprehensive Rice Research, University of California and U. S. Department of Agriculture. p. 1-32.

CONCISE GENERAL SUMMARY OF CURRENT YEAR'S RESULTS:

In May 1983 Dr. Seaman resigned from his appointment in the Department of Agronomy, University of California, Davis working at the Rice Experiment Station, Biggs. His weed control program was subsequently jointly supervised by Drs. D. E. Bayer and J. E. Hill, Departments of Botany and Agronomy, respectively, U.C. Davis. The weed control program included studies at the Rice Experiment Station, Biggs, the Rice Research Facility, Davis, the Demeter Corporation, Natomas District, and in miscellaneous on-farm trials in the rice growing counties.

Studies on the screening of new herbicides were conducted on the Rice Experiment Station and on the Rice Research Facility. Fifteen experimental herbicides were studied in total at the two locations. The most promising among the experimental herbicides included Hoe-33171 and RH

1903, both barnyardgrass herbicides. Hoe-33171 was in preliminary stages of testing in 1983 but has shown enough selectivity to warrant further studies. This herbicide represents a different chemistry than the currently used herbicides. RH-1903 is similar in chemistry to the herbicides molinate and thiobencarb but much safer to rice. The high rates of RH-1903 (8 lb ai/A) required to achieve acceptable control in 1983 are troublesome in view of the current public concern about water quality. Most of the experimental herbicides were unsuccessful in providing adequate weed control at the rates and times of application tested.

Several studies were conducted at the Rice Experiment Station and at the Demeter Corporation on herbicide combinations and timing of herbicide applications. The MCPA timing studies confirmed previous results that the early applications at 25 to 35 days provided better weed control and less depression on yield than did later applications at 45 or 55 days. Thiobencarb and molinate combinations did not injure the rice regardless of the sequence of applications as long as the growth stage requirements for rice and weeds were observed. All treatments including thiobencarb provided better sprangletop and smallflower umbrellaplant control than did molinate alone.

Studies integrating cultural practices and weed control included trials on the interaction of MCPA and bentazon with nitrogen fertilization and on herbicides and water management. Studies on barnyardgrass and rice competition conducted in 1981 and 1982 in the field were analyzed in detail as part of an M.S. thesis during the 1983 season. Previous studies have shown that MCPA applications may depress leaf tissue nitrogen in the rice plant following application for a period of approximately two weeks. Studies in 1983 were designed to determine more precisely the period of depression and whether or not the application of nitrogen can overcome this effect. The leaf tissue analysis is not completed, therefore the results will be reported later. Water management studies were conducted at the Rice Experiment Station and at the Demeter Corporation, Sacramento County. Preliminary data from these trials clearly indicate the importance of at least 3 to 4 inches of water to enhance weed control treatments. Detailed analysis has not been completed on these tests.

Greenhouse and laboratory studies have expanded our knowledge of germination of smallflower umbrellaplant. In addition to a definite temperature response smallflower umbrellaplant seed has a light requirement for germination that cannot be offset by increasing temperature. This light requirement further delays the emergence of seedlings until clods in newly-flooded fields disappear.

Germination of barnyardgrass seed occurs over a wide range of temperatures. When the germination of early and late barnyardgrass seed were compared under identical conditions early barnyardgrass was shown to germinate quicker than late barnyardgrass. This was especially true at the cooler temperatures.

Table 1. Performance of Hoe-33171 in water-seeded rice at U.C. Davis.

			Weed Control*			Rice				
			Barnyardgrass		Roughseed bulrush	Stand	Injury**		Height	Yield
Herbicide	Rate lb/A	Timing	7/8	8/12	8/12	(2 ft^2)	7/8	8/12	% control	% control
Hoe-33171	0.075	3" BYG	8.3	5.0	0.0	12	2.0	1.6	97	176
Hoe-33171	0.15	3" BYG	10.0	8.3	0.0	14	3.3	2.0	88	179
Hoe-33171	0.3	3" BYG	10.0	10.0	0.0	9	5.3	4.0	87	124
Hoe-33171	0.075	5" BYG	5.0	1.0	0.0	15	1.3	0.6	98	168
Hoe-33171	0.15	5" BYG	9.0	7.6	0.0	14	2.6	1.0	97	142
Hoe-33171	0.3	5" BYG	10.0	10.0	0.0	11	3.7	2.1	100	191
Hoe-33171+ Basagran	0.15 & 1.0	5" BYG	8.3	7.0	7.6	13	2.0	0.3	98	229
Hoe-33171	0.075	9" BYG	--	3.0	0.0	12	--	3.3	95	134
Hoe-33171	0.15	9" BYG	--	5.0	0.0	13	--	4.6	92	86
Hoe-33171	0.3	9" BYG	--	7.6	0.0	12	--	4.0	91	108
Propanil	5.0	9" BYG	--	6.6	4.3	10	--	0.6	91	208
Bolero	4.0	2-leaf rice	9.3	9.0	5.7	17	0.3	0.3	102	375
Control	--	--	1.0	0.6	0.0	11	0.0	0.0	100	100

* 0 = no control; 10 = all killed.
** 0 = no injury; 10 = all rice killed.

Table 2. Performance of Hoe-33171 in water-seeded rice, Biggs.

Herbicide	Rate lb/A	Timing	Weed Control* Barnyardgrass Early	Weed Control* Barnyardgrass Late	Weed Control* Roughseed bulrush	Rice Height % control	Rice Yield % control
Hoe-33171	0.1	1-2 leaf BYG	7.5	2.3	4.8	98	113
Hoe-33171	0.2	1-2 leaf BYG	7.8	0.0	2.8	91	90
Hoe-33171	0.4	1-2 leaf BYG	8.5	0.5	2.5	99	98
Hoe-33171	0.1	3-4 BYG	8.0	2.3	3.0	92	108
Hoe-33171	0.2	3-4 BYG	7.3	2.4	3.0	89	105
Hoe-33171	0.4	3-4 BYG	8.1	1.5	1.0	91	92
Hoe-33171	0.1	Tillering	7.8	0.0	3.5	92	97
Hoe-33171	0.2	Tillering	7.8	4.0	4.3	92	114
Hoe-33171	0.4	Tillering	9.0	8.5	3.0	88	136
Ordram	3.0	PPI	9.2	5.5	3.0	85	131
Bolero	4.0	2L BYG	7.6	0.3	1.0	91	92
Untreated	--	--	5.7	2.2	3.5	100	100

* 0 = no control; 10 = all killed.

Table 3. The influence of surfactants on the performance of Hoe-33171 in water-seeded rice, Biggs.

	Formulation	% X-77	Rate lbs ai/A	Grass burn	Sm-Fl rating	RSBR rating	Plant height % untreated	Yield (cwt) % untreated
Hoe-33171 10" rice	0.75	--	0.15	3.50	0.75	6.00	99	111
Hoe-33171 10" rice	0.75	--	0.30	6.50	1.25	5.00	96	97
Hoe-33171 10" rice	1.00	--	0.30	2.00	1.00	7.25	96	97
Hoe-33171 10" rice	0.75	--	0.45	4.50	0.88	7.25	95	95
Hoe-33171 10" rice	0.75	0.50	0.15	4.50	1.00	6.75	93	78
Hoe-33171 10" rice	0.75	0.50	0.30	6.75	0.88	6.25	92	89
Hoe-33171 10" rice	0.75	0.50	0.45	4.00	0.75	7.50	90	90
Hoe-33171 15" rice	0.75	--	0.30	1.25	1.63	6.50	80	81
Hoe-33171 15" rice	0.75	--	0.45	0.50	0.75	6.75	88	83
Hoe-33171 15" rice	0.75	0.50	0.30	0.00	0.50	5.50	88	86
Hoe-33171 15" rice	0.75	0.50	0.45	0.75	1.50	5.75	88	77
Untreated	--	--	--	1.25	1.50	6.00	100	100
% CV	--	--	--	73.50	89.20	31.10		
LSD (.05)	--	--	--	3.13	--	--		
(.01)	--	--	--	4.21	--	--		

Weed control evaluations are on a scale from 1-10, with 10 being the highest population.
Grass burn ratings are on a scale from 1-10, with 10 being the most severe burn.

Table 4. Performance of new herbicides in water-seeded rice.

Location	Herbicide	Rate lb/A	Timing	Weed Control* Barnyardgrass Early	Weed Control* Barnyardgrass Late	Weed Control* Roughseed bulrush	Rice Stand (2 ft^2)	Rice Yield % control
Biggs	DPX-5384	50 g/ha	2-leaf rice	6.0	4.5	8.8		116
	DPX-5384	100 g/ha	2-leaf rice	6.5	2.2	6.5		97
	DPX-5384	150 g/ha	2-leaf rice	6.5	3.0	7.8		105
	DPX-5384	200 g/ha	2-leaf rice	8.0	5.5	7.2		124
	DPX-5384	400 g/ha	2-leaf rice	7.8	6.5	9.5		120
	DPX-5384	50 g/ha	4-leaf rice	5.2	2.2	7.1		101
	DPX-5384	100 g/ha	4-leaf rice	6.0	4.0	9.2		109
	DPX-5384	150 g/ha	4-leaf rice	5.7	4.5	8.6		109
	DPX-5384	200 g/ha	4-leaf rice	6.2	5.5	10.0		120
	DPX-5384	400 g/ha	4-leaf rice	7.2	6.8	9.1		117
	Untreated	--	--	5.0	2.5	9.1		100
	Ordram	3.0	PPI	5.5	6.5	7.4		116
UCD	Ordram + 33865	3.0 & .6	PPI	7.0		0.0	21	191
	Ordram	3.0	PPI	5.0		0.0	15	192
	Ordram	5.0	2-leaf rice	10.0		0.0	14	200
	Bolero	4.0	2-leaf rice	9.6		3.3	18	150
	FMC-72980	0.5	2 1/2 leaf rice	0.6		0.0	19	77
	FMC-72980	1.0	2 1/2 leaf rice	2.6		0.0	14	103
	FMC-72980	2.0	2 1/2 leaf rice	3.6		0.0	15	104
	SC-2975	0.75	PFS	3.0		0.0	18	147
	SC-2975	1.5	PFS	4.3		0.0	16	153
	SC-2975	3.0	PFS	6.0		0.0	19	165
	DPX-5384	75	1-2 leaf rice	2.6		0.0	18	110
	DPX-5384	100		1.0		0.3	18	113
	DPX-5384	150		3.3		0.3	16	110
	DPX-5384	200		5.0		0.0	18	128

* 0 = no control; 10 = all killed.

Table 5. The effect of time of MCPA application on weed control and rice yield.

Treatment	Time of[1] application (DAS)	Weed Control[2]	Rice yield (cwt)
Sacramento			
MCPA	25	6.3	72
	35	8.5	78
	45	5.3	67
	55	6.0	69
Untreated	--	0.7	37
Biggs			
MCPA	25	7.2	54
	35	9.9	52
	45	9.7	53
	55	8.5	54
Untreated	--	7.0	56

[1]DAS = days after seeding.

[2]0 = no weed control; 10 = all weeds killed.

Table 6. The effect of Basagran application on weed control and rice yield.

Treatment	Time of[1] application (DAS)	Weed Control[2]	Rice yield (cwt)
Sacramento			
Basagran	25	5.0	58
	35	7.0	62
Untreated	--	1.7	52
Biggs			
Basagran	25	5.0	66
	35	2.1	61
Untreated	--	3.1	60

[1]DAS = days after seeding.

[2]0 = no weed control; 10 = all weeds killed.

Table 7. Effect of timing of Bolero on rice stand establishment and weed control.

Herbicide	Rate lb/A	Timing	Rice stand plants/sq ft	Yield cwt	Weed control* BYG	SFUP	Red stem
Bolero	4	Preflood inc.	9	58	10.0	5.0	5.7
	4	Preflood surface	8	57	10.0	5.3	6.0
	4	Postflood preseed	5	26	10.0	7.0	4.7
	4	Postflood 1-leaf	6	45	10.0	5.7	5.3
	4	Postflood 2-leaf	9	59	9.8	5.0	5.0
Control	-	--	8	37	3.5	1.0	1.3

* 0 = no control; 10 = all killed.

Table 8. The effect of Ordram and Bolero combinations on rice injury and weed control.

Herbicide	Rate lb/A	Timing	Rice stand plants/sq ft	Weed Control* Barnyard-grass	Sprangletop	SFUP	Red stem	Yield cwt
Ordram	3	PPI	5	10	6	0	0	55
Ordram	3 & 3	PPI & 1-leaf rice	6	10	5	0	0	58
Ordram	3 & 5	PPI & 2-leaf BYG	8	10	5	0	0	59
Ordram + Bolero	3 & 4	PPI & 2-leaf BYG	7	10	10	5	4	55
Ordram	3	1-leaf rice	4	10	7	0	0	54
Ordram	5	1-leaf rice	5	10	5	1	0	57
Ordram + Bolero	3 & 4	1-leaf rice & 2-leaf BYG	9	10	10	7	6	60
Ordram + Bolero	5 & 4	1-leaf rice & 2-leaf BYG	5	10	10	7	5	61
Ordram	3 & 3	1-leaf rice & 4" BYG	7	10	6	0	0	54
Ordram	3 & 5	1-leaf rice & 4" BYG	8	10	5	0	0	56
Ordram	5 & 3	1-leaf rice & 4" BYG	6	10	7	0	0	47
Ordram	5 & 5	1-leaf rice & 4" BYG	7	10	6	0	0	57
Ordram	3	4" BYG	4	8	6	0	0	42
Ordram	5	4" BYG	9	10	7	0	0	45
Bolero	4	2-leaf rice	6	9	10	5	5	54
Bolero	4 & 4	2-leaf rice & 2-leaf BYG	7	10	10	7	7	56
Bolero + Ordram	4 & 3	2-leaf rice & 4" BYG	7	10	10	4	6	58
Bolero + Ordram	4 & 5	2-leaf rice & 4" BYG	5	10	10	5	5	54
Control	--	--	8	3	5	0	0	37

*Weed control ratings: barnyardgrass - 0 = 1 plant/sq. ft.; sprangletop - 0 = 1/2 plant/sq. ft.; smallflower umbrellaplant - 0 = 15 plants/sq. ft.; red stem - 0 = 11 plants/sq. ft.

Table 9. Varietal tolerance of rice grown in the greenhouse to Hoe-33171 applied postemergence.

Variety	Height as % of untreated				Weight as % of untreated			
	.3 lb/A	.15 lb/A	.075 lb/A	Untreated	.3 lb/A	.15 lb/A	.075 lb/A	Untreated
M-9	78	86	100	100	76	109	121	100
S-201	76	93	98	100	69	110	103	100
M-201	74	92	96	100	53	100	96	100
Cal Pearl	83	96	100	100	65	97	110	100
L-201	81	100	104	100	59	90	87	100
Barnyardgrass	63	56	59	100	.02	.02	.03	100

Table 10. Percent germination of early and late barnyardgrass germinated on a temperature gradient bar, 1983.

Temperature °C	Days from planting to germination												
	2	3	4	5	6	8	9	10	11	12	13	14	15
	Early Barnyardgrass												
30	58	16	0	0	0	0	0	0	0	0	0	0	0
28	30	52	2	0	0	0	0	0	0	0	0	0	0
26	10	64	10	0	2	0	0	0	0	0	0	0	0
24	4	72	12	2	0	0	0	0	0	0	0	0	0
22	0	58	14	0	0	0	0	0	0	0	0	0	0
20	0	4	64	0	0	2	0	0	0	0	0	0	0
18	0	0	48	28	0	2	0	0	0	0	0	0	0
16	0	0	0	18	22	18	0	0	0	2	0	0	0
13	0	0	0	0	0	30	30	0	6	8	2	0	2
	Late Barnyardgrass												
30	12	62	20	0	0	2	0	0	0	0	0	0	0
28	0	60	26	0	0	0	0	0	0	0	0	0	0
26	0	32	34	2	0	2	0	0	0	0	0	0	0
24	0	18	68	2	0	0	0	0	0	0	0	0	0
22	0	4	56	12	6	2	0	0	0	0	0	0	0
20	0	0	38	44	10	0	0	0	0	0	0	0	0
18	0	0	6	20	30	4	0	0	0	0	0	0	0
16	0	0	0	0	10	64	10	2	0	0	0	0	0
13	0	0	0	0	0	4	12	14	26	6	6	0	0